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AUTHOR	Espinosa, Renato; And Others
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ABSTRACT

The Reinstein Reinforcement Schedule, based on a simple program of reinforcement for success and nonreinforcement for failure, was one of the important variables introduced in the University of Texas 1968-69 Head Start Intervention Study. The effect of the schedule was assessed as part of an evaluation of the Buchanan Language Program. Three groups of children were compared: A group of Negro English-speaking children, a group of Mexican-American children whose first language was Spanish (who were tested throughout the language program with the Schedule), and a second Mexican-American group who did not receive the schedule. The groups were compared for mastery of concepts in the language program and on the Metropolitan Reading Readiness Test to test for generalization of learning effects. Results controlled for ethnic group support the hypothesis that improved learning may result from the use of the Schedule. An investigation of possible effects of nonreinforcement, using a specially devised criterion, revealed no effects. Informal observation suggested that the positive effects of the Schedule could well be due to the additional practice the children receiving it obtained. (DR)

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John Pierce-Jones, Ph.D., Director

The University of Texas at Austin

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THE EFFECT OF THE REINSTEIN REINFORCEMENT SCHEDULE ON LEARNING OF SPECIFIC CONCEPTS CONTAINED IN THE BUCHANAN LANGUAGE PROGRAM

Renato Espinosa
Richard E. Reposa
John Pierce-Jones

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The Effect of the Reinstein Reinforcement Schedule on Learning of Specific Concepts Contained in the Buchanan Language Program

Renato Espinosa

Richard E. Reposa

John Pierce-Jones

The University of Texas at Austin

One of the important variables introduced as part of the 1968-69 Head Start intervention at The University of Texas was the Reinstein Reinforcement Schedule. The study which is to follow will focus upon this particular variable of the study.

Background

The general research design of the intervention study was as follows. Five experimental groups were set up within each of the two principal replications of the evaluation design. Replication one was made up entirely of Head Start children whose language experience had been with English. Replication two was composed of Head Start children whose first language experience had been with a language other than English, in this particular case, Spanish.

Within each of the two replications, five experimental groups were established. At this point, a short description of each of the

experimental groups might be helpful. Experimental Group 1 in each of the replications consisted of classes using only the basic intervention instrument: Readiness in Language Arts (Cynthia D. Buchanan, 1967). Each of the teachers was given a half day training locally in the use of the materials before actually using them in the classroom. In addition, she was to supplement the basic materials in any way she chose. The teachers in Experimental Group 2 received one-half day of orientation for clarifying the Buchanan Program. These two teachers also used a commercially prepared Buchanan Supplement. Experimental Group 3 was made up of teachers who were to use the Buchanan Language Program and also the Swanson Supplement. The teachers in this group received one-half day orientation in the use of the Buchanan Program. No formal training in the use of the Swanson Supplement was given. The teachers in Experimental Group 4 received one-half day orientation in the use of the Buchanan manual. In addition, each of the teachers in Group 4 received one week of formal training in the use of the Buchanan Language Program, and one week of training in the use of the Swanson Supplement. Formal training for teachers in Experimental Groups 4 and 5 was held at the University of South Carolina. Finally, the teachers in Experimental Group 5 received one week of training in the use of the Buchanan Language Program, one week of training in the use of the Swanson Supplement, and one week of formal training in the use of the Reinstein Reinforcement Schedule. As is obvious, the Reinstein Reinforcement Schedule is the variable which differentiates the program used by the teachers in Experimental Group 5 from that used by those in Group 4.

At this point, a detailed description of the Reinstein Reinforcement Schedule is necessary. The schedule was developed at the University of South Carolina by Barry Reinstein, a member of the Committee on Educational Research, directed by Myles I. Friedman. The intent of the Reinforcement Schedule was to assess the effect of a success-reward, failure-nonreward relationship on the learning and retention process of the child. In order to measure said effect, the child was reinforced with a piece of candy for a correct response to the task given and not reinforced for failure to complete the task successfully. In addition, for every four tasks completed correctly, the child received a small toy. This then is a description of the reinforcement procedure used during the course of the intervention study.

The Reinforcement Schedule itself attempted to measure the amount of retention on the part of the child while reinforcing his correct responses with some sort of reward; either candy or a toy. Each reinforcement lesson consisted of a series of three different activity sheets which were based upon material covered in the lesson for that day, or a review of concepts covered in the recent past. The three pictures in the series were arranged in order of difficulty; picture three being the most difficult and picture one the easiest of the three. Picture three usually contained a task requiring retention of concepts presented in the lesson for that day. Picture two contained a slightly easier task which had been presented that day, and finally picture one usually reviewed a concept presented previously.

In terms of the actual administration of the reinforcement sheets, the teacher presented sheet three first. The children who completed the task with success were reinforced with a piece of candy, and in addition, they were allowed free choice of activity for 15 minutes following the reinforcement lesson. The teacher explained the reason for failure to each of the children who did not succeed and presented them with picture two. Once again, the same procedure was followed. Finally, the teacher explained the reasons for failure on the part of those who did not succeed with picture two and presented picture one, the easiest of the three. Once again, the same procedure was used. Usually, the entire class had experienced success by the end of the series.

Based upon observation of the use of the Reinforcement Schedule, the following clarification is necessary. As previously stated, nearly all of the children achieved success by the end of the picture series. There were occasionally subjects who were unable to complete any of the pictures successfully. According to the guidelines of the intervention study, these children were not to receive candy, nor were they to be allowed free choice of activity. Rather they were to be assigned an activity by the teacher. For a number of reasons, it was extremely difficult for the teacher to enforce this particular portion of the design. The physical site was in many cases too small to allow for adequate isolation of the children from their peers during the activity period. In addition, it was very difficult to isolate the children who

had completed the first of the three pictures successfully from those who were to be presented either picture one or two. Practical considerations made absolute adherance to the guidelines in these respects nearly impossible. The desired effect of all reinforcements, including candy, toys, and activity selection, then, was to establish the relationship between success-reinforcement and free activity, and failure-nonreinforcement and activity assigned by the teacher.

Hypotheses

It is hypothesized that the group which is exposed to the Reinforcement Schedule will show greater learning of the task than a similar group not experiencing the Reinforcement Schedule. This greater learning will supposedly generalize to other cognitive and intellectual tasks and would express itself in greater gains on other cognitive tests. Within Experimental Group 5 (with Reinforcement Schedule) there should be differential learning as a function of the number of reinforced trials. This effect assumes that the reinforcement of performance in a testing situation will generalize to a learning situation. The reasoning on the part of the child would be: "If I pay attention and learn this I will be rewarded during the testing session." The reward for the last trial n acts as an incentive for learning the materials on the next trial (trial n+1). At the same time, the reward reinforces the correct response for trial n which will be part of the response elicited in trial n+1. This is so because of the cumulative character of the concepts and the arrangement of the Buchanan Program.

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The effect of the rewards are fairly straight forward. However, the possible effects of nonreinforcement are not altogether clear. It is possible to assume that nonreward for trial n acts as an inhibitor (as a frustrating event) that will interfere with the acquisition of the concepts on the next trial (trial n+1). On the other hand, if contingency is perceived between correct response and reward and incorrect response and nonreward, the deprivation of reward on trial n would produce a drive-like condition that could actually energize learning on the next trial (trial n+1) in order to obtain the reward.

The relative proportion of rewarded and nonrewarded trials is likely to affect the total level of learning of the tasks. It is proposed that subjects with a relatively larger proportion of nonrewarded trials will show less overall acquisition of the concepts being taught. Unfortunately, the actual mechanics of the reinforcement procedure make the preceding analysis inapplicable. There were very few instances of nonrewarded trials; almost all the children succeeded at least on the easiest task, making it impossible to get a distribution of subjects in terms of number of nonrewarded trials (or lessons).

An alternative strategy was devised to obtain a gross measure of the negative events that could influence the acquisition process. In the description of the Reinforcement Schedule we mentioned the fact that children were rewarded with an inexpensive toy every four (4) successful trials (or lessons). Since some of the children missed a picture from time to time (or were absent), their fourth success did

not come at the same time as it did for the rest of the class. Thus, there were days in which the majority of the children in a given class completed four successful trials and were given a toy, while some were not. Although those children who did not receive a toy could have known that they would get theirs the next day, that a Nonreinforcement Event (NRE) could possibly have an effect similar to a nonrewarded trial. By selecting days in which the majority of the children received toys, it was possible to count the number of Nonreinforcement Events (NRE) that each child experienced in each unit (Book) of approximately 17 lessons (days) each.

On the basis of this very gross estimate of negative experiences, we divided the Experimental Class 5 into high and low numbers of NRE's. These groups could then be compared in terms of their scores on the various instruments administered.

In interpreting the meaning of Nonreinforcement Events (NRE) it is important to keep in mind the factors that make this a fairly weak measure. To begin with, it is not known whether children knew that they would receive their toy the next day. If they knew it, this makes the NRE only slightly negative. On the other hand, casual observations by the authors revealed a general lack of interest in the toys involved. Often, some children gave their toy away, forgot to take it home, exchanged it for something else, or simply did not bother to go and get it from the teacher.

In spite of these problems, the number of NRE is the best possible estimate of negative experiences under the present overall design.

Description of Sample

The original sample consisted of thirty-five children from Experimental Groups 4 and 5 of the study design. In each of the classes, only those children who were selected to take part in the national evaluation could be included in the study, as these children had been given all of the instruments which would be used for comparative purposes in interpreting the results. In addition, the two Anglo children originally included in the sample were eliminated, since the authors intended to compare children by ethnic background and their number was not sufficiently large for consideration. Finally, the sample consisted of: an Experimental Group 5 made up entirely of Mexican-American children, an Experimental Group 5 composed entirely of Negro children, and a Control Group (Experimental Group 4) made up entirely of Mexican-American children.

Description of Instruments

The principal instrument consisted of a series of reinforcement activity sheets chosen at random from the first three books of the intervention program. At the conclusion of the intervention program, the teachers showed varying degrees of progress in the program. Some had completed as many as five of the six books in the series, while others had completed fewer lessons. In order to assure reliable

results, the authors decided to include sheets in the review instrument from only the first three books of the Buchanan Program. The procedure for selections was as follows: ten lessons were chosen at random from each of the first three books. Subsequently, the level of difficulty for the sheet of a given lesson was chosen as well.

In terms of the scoring procedure, the following information was necessary. Since any one of the three alternatives was possible for each lesson, and the sheets increased in level of difficulty from one to three, the authors decided to give one point credit for each picture numbered one, two points credit for each picture numbered two and three points credit for picture number three in each case. In addition, it was deemed necessary to allow for increasing difficulty from book one to three. To allow for this, credit for each picture in book two was multiplied by two and the score for each sheet in book three was multiplied by three. Three subscores were thus obtained, one for each of the three books. A total score was computed by adding the three subscores (see Table 1).

The testing with the instrument described above was done the week preceding the termination of the program. The Head Start teacher administered the Reinforcement Activity Sheet Test to her class in each case. The remaining instruments were administered during the posttesting for the national evaluation.

TABLE 1

Activity Sheets and Score Values Used For

the Reinforcement Activity Sheets Test

Book 1			Book 2			Book 3		
Lesson Number	Sheet Number	Score	Lesson Number	Sheet Number	Score	Lesson Number	Sheet Number	Score
1	1	1	4	3	6	1	3	9
2	3	3	6	3	6	2	2	6
3	2	2	7	1	2	4	2	6
4	1	1	8	2	4	5	1	3
7	2	2	9	1	2	6	3	9
8	2	2	10	1	2	8	1	3
9	1	1	11	3	6	10	3	9
12	1	1	12	1	2	12	1	3
13	1	1	14	1	2	14	1	3
14	1	1	16	1	2	15	2	6
Total Book 1		15	Total Book 2		34	Total Book 3		57

Book 1 Total Score = 15
Book 2 Total Score = 34
Book 3 Total Score = 57

Grand Total Score = 106

Predictions

1. In general, we should expect the Reinforcement Schedule to increase acquisition and performance of the specific concepts taught with the Buchanan Program. Thus, we expect Experimental Group 5 (with the Reinforcement Schedule) to score higher than Experimental Group 4 (without the Reinforcement Schedule).
2. Within Experimental Group 5 (with reinforcement), the high NRE Group should score lower than the low NRE Group <u>if</u> nonreinforcement has a negative (inhibitor) effect on learning. The opposite would be expected if nonreinforcement produces a drive-like state or if the toys act as an incentive for learning and performance.

These same results are expected on the Metropolitan Reading Readiness Test as a generalization effect.

Results

Table 2 presents the distribution statistics for the various instruments used. Means, standard deviations, and ranges are given. On the basis of the first hypothesis we expected those classes taught with the Buchanan Reading Program plus the Reinforcement Schedule to score higher than classes without the Reinforcement Schedule, particularly when measured with a test composed of selected Activity Sheets used in the Reinforcement Schedule. The Reinforcement Activity Sheets

TABLE 2

Distribution Statistics for Instruments Used

Total Sample N = 33

Instrument	Mean	S. Dev.	Range
Reinforcement Activity Sheets Test			
Book 1	13.77	1.26	11 - 15
Book 2	24.74	6.51	10 - 34
Book 3	45.86	11.72	24 - 57
Total Score	84.40	16.89	49 - 106
Stanford-Binet			
Chronological Age	72.72	4.01	67 - 79
Mental Age	66.18	7.55	52 - 82
IQ	90.31	13.14	63 - 121
Metropolitan Reading Readiness Test			
Total Score	46.78	12.53	24 - 72
Percentile Rank	36.84	21.20	7 - 84

Test was basically a review of specific concepts using exactly the same stimulus (or item) with which children were tested and reinforced as part of the reinforcement procedure. Furthermore, the groups without the Reinforcement Schedule had never seen these particular materials. Table 3 presents a comparison of these two groups (with and without the Reinforcement Schedule). The analyses of variance performed with the various instruments reveal no significant differences whatsoever. From these data, it would seem that the introduction of the Reinforcement Schedule did not result in any significantly greater acquisition of the concepts taught with the Buchanan Program.

The next question to be answered is whether or not the number of Nonreinforcement Events (NRE) had any effect on the acquisition of the concepts introduced by the Buchanan Program. To ascertain this, subjects in the Experimental Group 5 (with Reinforcement Schedule) were divided at the median of the number of Nonreinforcement Events (NRE) to generate a low and high number of NRE Groups. In addition, the Experimental Group 4, with no Reinforcement Schedule constituted a suitable additional Control since no opportunities for NRE existed.

Table 4 presents the results of the analyses of variance. It can be seen that no significant differences were found on any of the measures. From these data, it is not possible to conclude with certainty that "negative" events did not affect learning of the Buchanan concepts. We can conclude, however, that our imperfect measure of negative events, the number of NRE, is not related to greater or less acquisition.

TABLE 3

Analysis of Variance of

Reinforcement Schedule Effect

Instrument Scores	Means: Exper. Grp. 5 (With Reinf.) N = 22	Means: Exper. Grp. 4 (Without Reinf.) N = 11	p
Reinforcement Activity Sheets Test			
Book 1 Score	13.91	13.46	n.s.
Book 2 Score	25.64	21.82	n.s.
Book 3 Score	46.77	42.82	n.s.
Total Score	86.36	78.09	n.s.
Stanford-Binet			
Chronological Age	71.85	74.30	.08
Mental Age	65.80	65.80	n.s.
IQ	90.95	87.40	n.s.
Metropolitan Reading Readiness Test			
Total Score	45.80	46.60	n.s.
Percentile Rank	35.65	35.40	n.s.

TABLE 4

Analysis of Variance of the Effect of

Number of Nonreinforcement Events

Instrument Scores	Control (Exper. Group 4) (Without Reinforcement) N = 11	Exper. Group 5 (Low NRE) N = 13	Exper. Group 5 (High NRE) N = 9	P
Reinforcement Activity Sheets Test				
Book 1 Score	13.42	13.94	14.00	n.s.
Book 2 Score	22.33	28.00	25.44	n.s.
Book 3 Score	43.25	47.00	47.25	n.s.
Total Score	79.00	87.43	86.89	n.s.
Stanford-Binet				
Chronological Age	74.55	71.77	71.75	n.s.
Mental Age	65.46	66.39	66.88	n.s.
IQ	86.55	92.23	92.38	n.s.
Metropolitan Reading Readiness Test				
Total Score	46.46	43.15	53.13	n.s.
Percentile Rank	35.00	31.15	48.63	n.s.

Our data can be analyzed in terms of classes (three of them) and also in terms of ethnic groups and sex. There were two classes using the Reinforcement Schedule (one all Mexican-American and one all Negro) and one class without the Reinforcement Schedule (all Mexican-American). Table 5 presents the comparison of classes. It can be seen that there are significant differences between classes on all variables except for the Stanford-Binet's Mental Age and IQ. Class 1, composed of Mexican-American children using the Reinforcement Schedule is consistently better on every test considered. A similar analysis in terms of ethnic group and sex was performed and the results are presented in Table 6. When Mexican-American subjects are tested against Negroes, there are still significant differences on Book III and Total Score for the Reinforcement Activity Sheets Test, as well as in Chronological Age, and the two scores for the Metropolitan Reading Readiness Test. There are also some sex differences but no interaction effects.

Conclusions

When possible ethnic or class differences are controlled for, it seems clear that the group experiencing the Reinforcement Schedule attained a higher level of learning of the specific concepts involved in the Buchanan Program. This would tend to confirm our first hypothesis. It is also clear that this greater learning was detected with the Metropolitan Reading Readiness Test as a result of a generalization of learning phenomena.

TABLE 5

Analysis of Variance by Classes

Instrument Scores	Mex. Am.-Reinf. Class 1 N = 12	Negro-Reinf. Class 2 N = 10	Mex. Am.-No Reinf. Class 3 N = 11	P
Reinforcement Activity Sheets Test				
Book 1 Score	14.38	13.40	13.45	.01
Book 2 Score	30.00	20.80	22.36	.004
Book 3 Score	55.62	36.30	43.91	.001
Total Score	100.00	70.60	79.73	.001
Stanford-Binet				
Chronological Age	73.09	70.30	74.10	.001
Mental Age	67.64	65.40	65.40	n.s.
IQ	92.36	92.20	87.00	n.s.
Metropolitan Reading Readiness Test				
Total Score	55.27	37.80	46.50	.001
Percentile Rank	51.36	22.90	35.20	.003

TABLE 6

Two-way Analysis of Variance of Total Sample

Classified by Ethnic Group and Sex

Instrument Scores	Ethnic Group			Sex		
	Negro	Mex.Am.	p	Male	Female	p
	Means			Means		
Reinforcement Activity Sheets Test						
Book 1 Score	13.32	13.97	n.s.	13.40	13.88	n.s.
Book 2 Score	21.57	25.50	n.s.	22.83	24.23	n.s.
Book 3 Score	38.55	47.60	0.3	37.80	48.35	0.1
Total Score	73.52	87.06	.07	74.03	80.55	.04
Stanford-Binet						
Chronological Age	70.03	73.52	.02	71.32	72.23	n.s.
Mental Age	65.40	65.72	n.s.	67.15	63.97	n.s.
IQ	92.60	88.55	n.s.	93.68	87.45	n.s.
Metropolitan Reading Readiness Test						
Total Score	36.53	49.93	.005	40.90	45.56	n.s.
Percentile Rank	20.80	41.77	.01	28.80	33.77	n.s.

Relevant data for Negro subjects with and without the Reinforcement Schedule presented elsewhere in this Final Report also confirm these findings. Negro subjects in Experimental Group 5 scored lower than Negro subjects in Experimental Group 4 in both pre- and posttest with the Metropolitan Reading Readiness Test. The rate of gain from pre- to posttest, however, was twice as large for the group experiencing the Reinforcement Schedule. It can be said, then, that the Reinforcement Schedule had a positive effect on both the learning of specific concepts of the Buchanan Program (as measured by the Reinforcement Activity Sheets Test) and also on the performance on the Metropolitan Reading Readiness Test.

On the other hand, the failure to find differential learning as a result of "negative" events (nonreward) that occurred during the Reinforcement Schedule raises important questions relative to the mechanics of the reinforcement procedure itself. With our data we are justified in saying that suspected "negative" events did not affect total level of learning, either increasing or decreasing it. With this information and informal observation of the actual procedure we would contend that the crucial elements in the Reinforcement Schedule were the rehearsal, repetition and practice of concepts learned and not the rewards (candy and toys) given or withheld. It can be argued that the candy and toys only added to the already heavy workload of the teacher without resulting in greater learning on the part of the children. Unfortunately, this study was designed to obtain some

information about the learning of specific concepts of the Buchanan Program and not to test the advantages or disadvantages of giving or withholding candy and/or toys. We have been limited by the general experimental design of the intervention procedure. It seems to us that it is not enough to demonstrate that the Reinforcement Schedule has positive effects on learning. We should be able to determine what specific aspects of the total program are responsible for this effect. Our study only suggests areas for future research.